



Introduction to Lift Plans

An Online Continuing Education Course for Engineers

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Introduction to Lift Plans

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Introduction

Lifting with cranes and gantries is essential to construction and maintenance contractors to move equipment and materials. Cranes can be fixed or mobile, such as a tower crane or boom truck, and are commonly used in construction activities. Gantry and overhead cranes are typically built into a building or structure and are used more frequently in maintenance and operations.

Cranes provide the muscle to perform a lift, and rigging attaches the crane to the object being moved. No matter the type of crane or application, these types of lifts all depend on the crane and rigging having the adequate structural strength to withstand the weight of the load, and the crane remaining stable during lifting. If the crane or rigging are not strong enough to withstand the load being placed on them, they will fail, and if the crane becomes unstable during the lift, the crane will topple. Either one of these scenarios is extremely dangerous, not to mention the potential for financial impacts from a damaged crane or equipment.

Considering the consequences, most lifts utilizing cranes now require a lift plan. Lift plans typically include the make, model, and capacity of the crane; the type, capacity, and configuration of the rigging to be used; and the size and weight of the object to be lifted. Other pertinent information may be required, such as manufacturers specifications for the crane, product data for the rigging, operator's certifications, rigging calculations, structural calculations for the pick points on the load, a drawing of the travel path of the load, soil bearing capacity calculations, a diagram of the area where the lift will take place, and a list of the hazards that have been identified for the particular lift the lift plan is addressing.

An introduction and an explanation of what goes into lift plans will be presented in this course, including terminology, regulations, typical lifting considerations, and identification/mitigation of risks.

The course outline is as follows:

1. Terminology
2. Crane Selection
3. Rigging
4. Risk Identification and Mitigation

Appendix 1 – Regulations

Appendix 2 – Sample Lift Plan Technical Specification

Terminology

Bearing Capacity:	The capacity of the surface to support a load typically expressed as pounds per square foot.
Boom Angle:	The angle of the main boom relative to the horizontal.
Cab:	Where the operator of a crane sits. Some cranes do not have a cab.
Capacity:	Safe working limit, as a weight measurement, of a crane or piece of rigging. Capacity can change based on the way a crane is a set-up or the configuration of rigging.
Counter Weight:	A weight attached to a crane to counterbalance the weight of the load being lifted. Mobile cranes and some fixed crane rely on counterweights to prevent the crane from tipping while lifting.
Fixed Crane:	A crane that is in a permanent or semi-permanent location. Fixed cranes are built into either a building or structure or are erected for an extended duration. Examples include tower cranes, overhead cranes, bridge cranes, and gantries.
Girder or Gantry Beam:	The main support structure or beam of an overhead crane. Typically, a trolley will be attached and travel along the girder/beam.

Hoist Line or Cable:	Wire rope that connects the boom (mobile cranes) or trolley (fixed cranes) to the hook.
Jib:	On a mobile crane, this is an extension of the main boom that is attached to the tip of the main boom and can be stowed when not in use. On a tower crane, the jib is the horizontal structure that the trolley is attached to.
Load:	The object being lifted.
Load Chart:	Table of the capacity of a crane given the crane's set-up and configuration. Some overhead cranes may have a maximum capacity specified by the manufacturer.
Main Boom:	On a mobile crane, this is the main arm of the crane that extends outward from ground level.
Main Hook/Block:	Hook, block, and tackle that connect the hoist line to the rigging.
Main Pin:	On a mobile crane, this is where the main boom attaches to the body of the crane.
Mat/Cribbing:	On a mobile crane, supports placed under outriggers to distribute the load placed on the outriggers. Mats/cribbing act like a footing supporting a column in a building.
Mobile Crane:	A crane that can be moved from site to site. Mobile cranes typically require some set-up and break down when they moved to a new site. Examples include hydraulic cranes, carry decks, lattice boom crawler cranes, and boom trucks.
Outrigger:	On a mobile crane, outriggers are extendable feet that give the crane a wider base, thus adding stability to the crane. Crawler cranes do not have outriggers; however, some crawler cranes have tracks that can be extended.

Range Diagram:	A plan and elevation of the area in which a crane can lift.
Rigging:	The equipment or devices used to connect the hook of the crane to the load to be lifted. Examples of rigging include chokers, slings, chains, shackles, and spreader bars.
Tip Height/Max Boom Height:	on a mobile crane, the maximum height of either the boom or jib, measured from ground level.
Turntable:	on a crane that can rotate, the section of the crane between the fixed and rotating parts of the crane.
Working Radius:	on a mobile crane, this is the horizontal distance from the main pin to the center of gravity of the load. On a tower crane, the distance from the turntable to the center of gravity of the load.

Crane Selection

Choosing the proper crane for a lift is a straight forward process. Overhead and tower cranes have a static range and capacity, and when using these types of crane, they will either be suitable or unsuitable for the lift. Mobile cranes have many adjustments that can be made, such as boom length, counterweights utilized, outriggers, set-up location, and attachments to the boom. Depending on the configuration and set-up location of a mobile crane, it may or may not be suitable for a lift. Determining if a crane will be appropriate for a lift requires reviewing the manufacturer's specifications, with special attention to the crane's load chart and range diagram.

Overhead cranes typically have a limited path of travel and set capacity. If the load exceeds the overhead crane's capacity or the load needs to be moved outside of the operating range of the crane, the overhead crane is inadequate, and other options need to be considered. If the load exceeds the capacity of an overhead crane, a mobile crane can be brought in, or the load may be altered/disassembled to reduce the overall weight. If the load needs to be moved

to a location outside the range of the overhead crane, another piece of equipment is needed to move the load. Tower cranes have a similar restriction on capacity and range. However, the capacity of the tower crane is inversely proportional to the working radius of the lift.

Tower cranes may have adequate capacity to lift a heavy piece of equipment off of a truck parked 20' from the base of the crane, but not enough capacity to move the equipment to a location 150' away from the base of the crane. The same is true for mobile cranes. Always use the maximum working radius of the lift to determine crane capacity. Tower cranes are simpler than mobile cranes in that the load chart on a tower crane is dependent on the working radius. A mobile crane's load chart is dependent on a working radius, boom length or boom angle, outriggers, and whether or not a jib is attached. Reviewing a crane's load chart is one of the most important parts of lift planning. The following are examples of a tower crane and mobile crane load chart.

Radius - ft	10	16	33	49	66	82	98	123	131	148	162	180	201	213	234	246	267
Capacity - lb	44,090	44,090	44,090	44,090	44,090	44,090	37,920	29,960	27,845	24,425	21,960	19,400	16,995	15,875	141,100	13,230	11,900
Max Hook Radius	267 ft																
Max Radius at Max Capacity	44,090 lb @ 85 ft																

Tower Crane Load Chart 1

19,200 lb Counterweight - Fully Extended Outriggers - 360 Degree Rotation												
(All Capacities Are Listed In Pounds)												
Boom Length (ft)												
Radius (ft)	40	50	60	70	80	90	100	110	120	130	140	Radius (ft)
5	180,000											5
10	160,000	152,000	117,900	70,800								10
15	138,000	138,600	108,800	70,800	85,100							15
20	109,500	111,700	106,500	70,800	78,400	54,200						20
25	80,100	82,400	82,800	63,500	76,500	52,000	49,100	27,200				25
30	62,000	64,300	64,800	54,800	64,300	45,800	45,200	36,300	28,000	26,900		30
35	49,700	52,000	52,600	47,800	52,100	40,600	42,200	35,900	28,000	26,500	24,400	35
40		42,900	44,100	42,500	42,800	36,500	38,300	35,500	28,000	26,300	24,100	40
45		34,300	34,800	35,000	35,100	33,000	34,700	33,400	28,000	26,100	24,000	45
50			28,100	28,400	28,500	28,500	28,100	27,500	26,100	25,900	23,800	50
55			23,200	23,800	23,700	23,800	23,300	23,800	24,100	24,800	23,700	55
60			19,000	20,800	21,300	20,000	21,300	21,700	21,300	20,900	20,500	60
65				18,400	18,800	18,300	18,800	18,700	18,300	17,900	17,600	65
70					16,300	16,500	16,400	15,900	15,900	15,500	15,100	70
75					14,300	14,500	14,400	14,300	13,900	13,500	13,200	75
80						12,800	12,800	12,700	12,300	12,000	11,600	80
85						11,400	11,300	11,200	10,900	10,500	10,200	85
90							10,100	10,000	9,700	9,300	9,000	90
95							9,000	8,900	8,800	8,200	7,900	95
100								8,000	7,700	7,300	7,000	100
105								7,100	6,800	6,500	6,200	105
110								4,200	6,100	5,700	5,400	110
115									5,400	5,100	4,700	115
120										4,500	4,200	120
125										3,900	3,800	125
130											3,100	130

To view the remainder of the course material and to take the quiz for PDH credit, you must purchase the course.

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The table for the capacity of the pick is made at 165' 180' is 19,400 pound listed in the table, in the radius or interpol crane manufacturer.

Mobile crane loc or set-up, in many diff Fully Extended Outrigg

is listed across the top, with of the tower crane be if a ' is 21,960 pounds and at up to the nearest radius pounds. Rounding down specifically allowed by the

one can be configured, choice in the chart title it mentions Fully Extended Outriggers